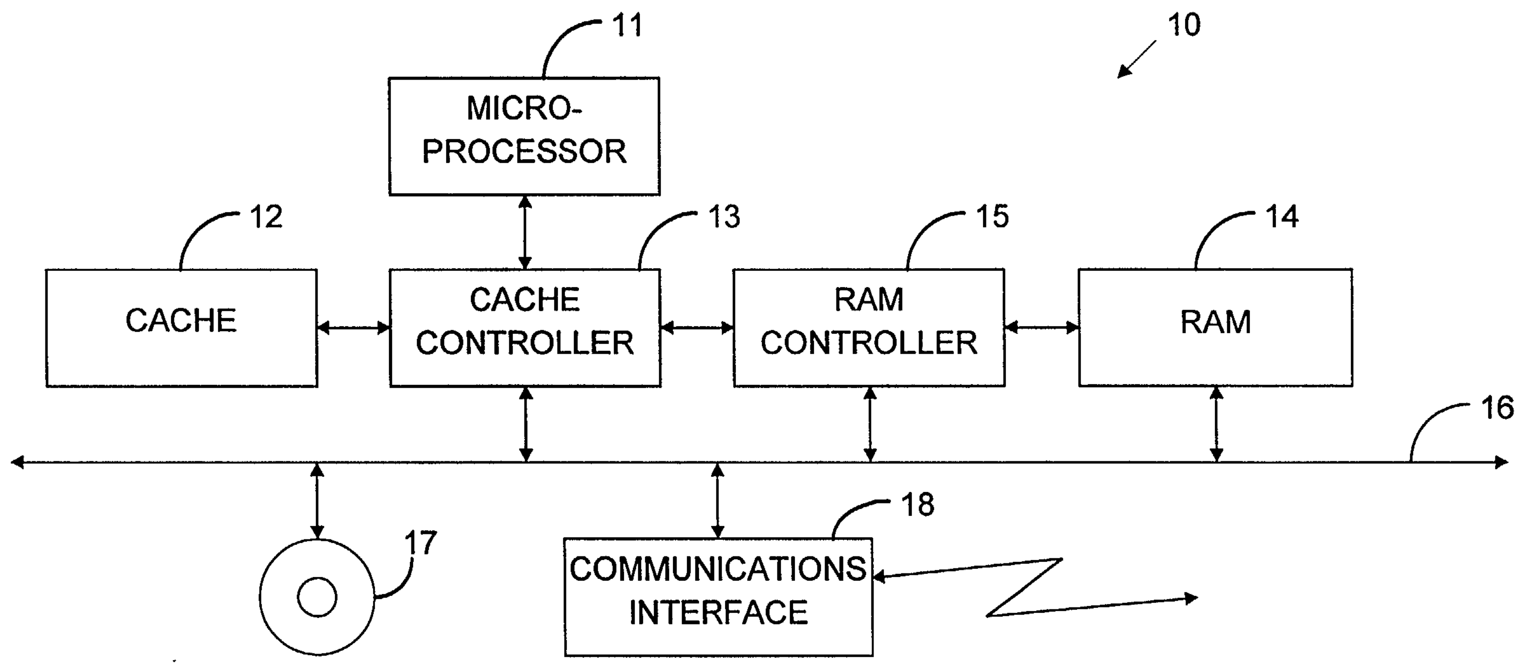

10
11
MICRO-
PROCESSOR
12
CACHE
13
CACHE
CONTROLLER
15
RAM
CONTROLLER
14
RAM
16
17
18
COMMUNICATIONS
INTERFACE

FIG. 1

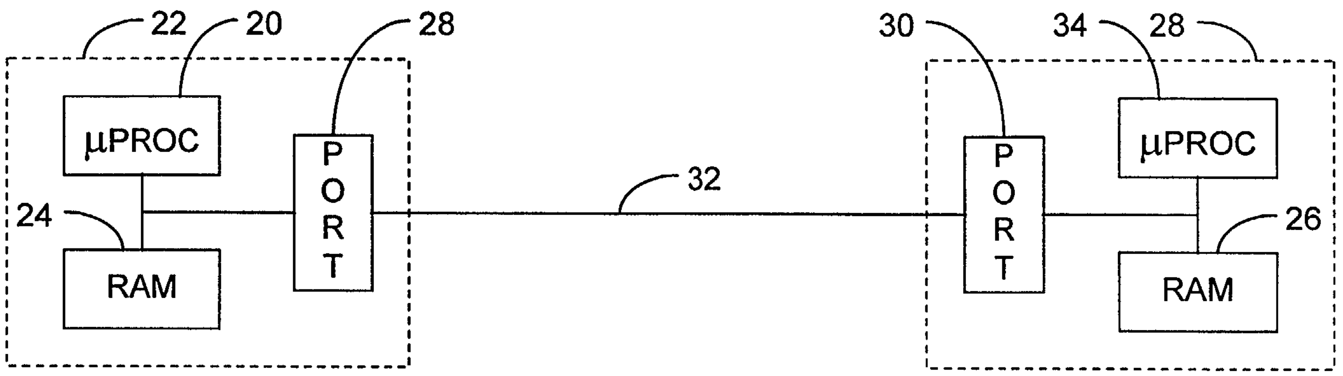

22
20
28
30
34
28
μPROC
24
RAM
P O R T
32
P O R T
μPROC
26
RAM

FIG. 2

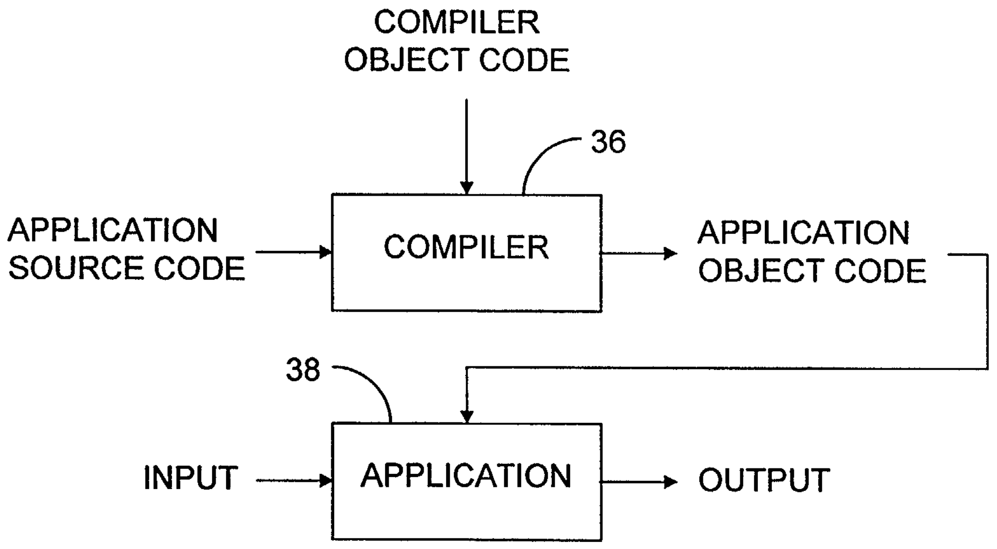

COMPILER OBJECT CODE
36
APPLICATION SOURCE CODE
COMPILER
APPLICATION OBJECT CODE
38
INPUT
APPLICATION
OUTPUT

FIG. 3

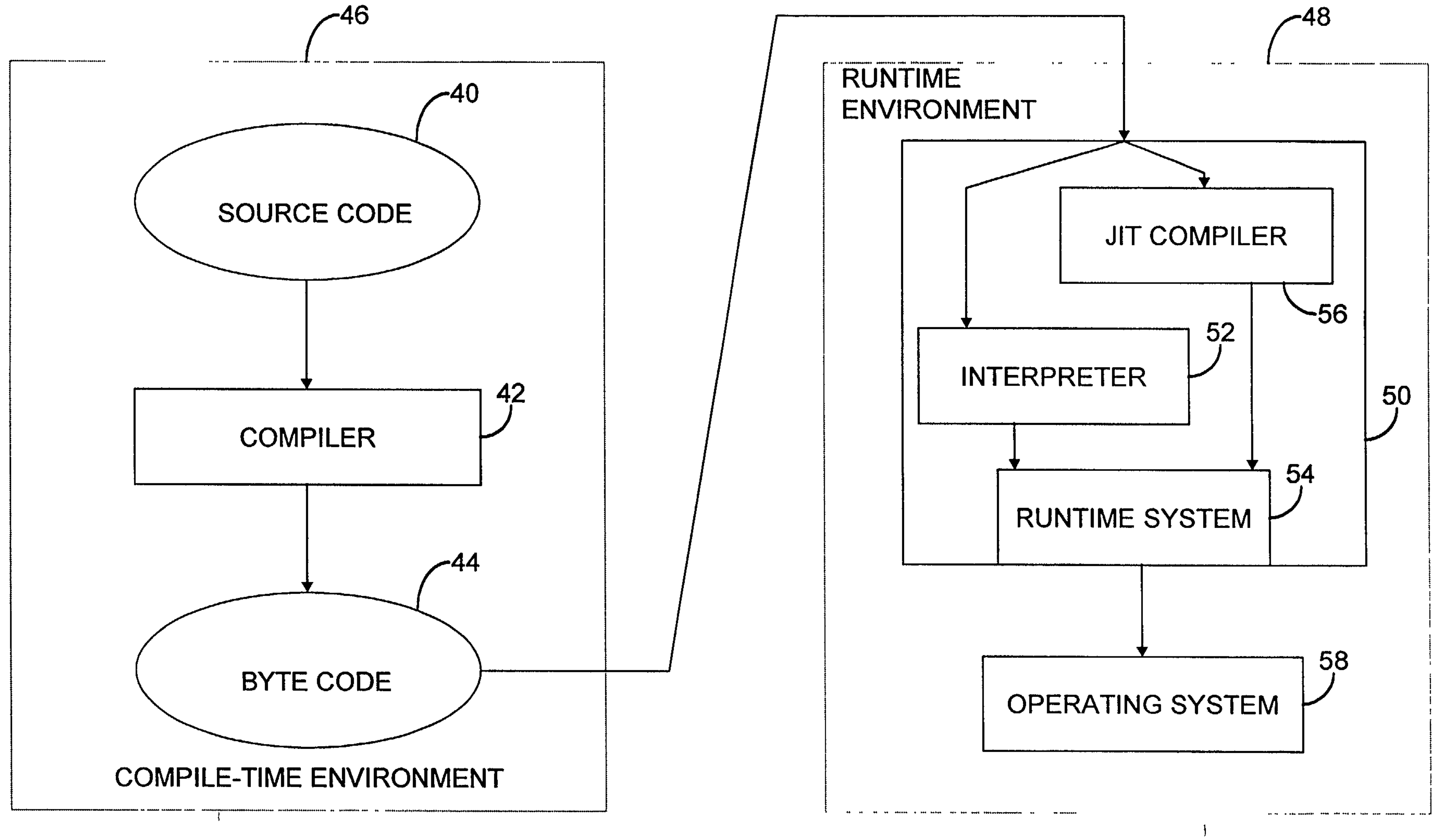
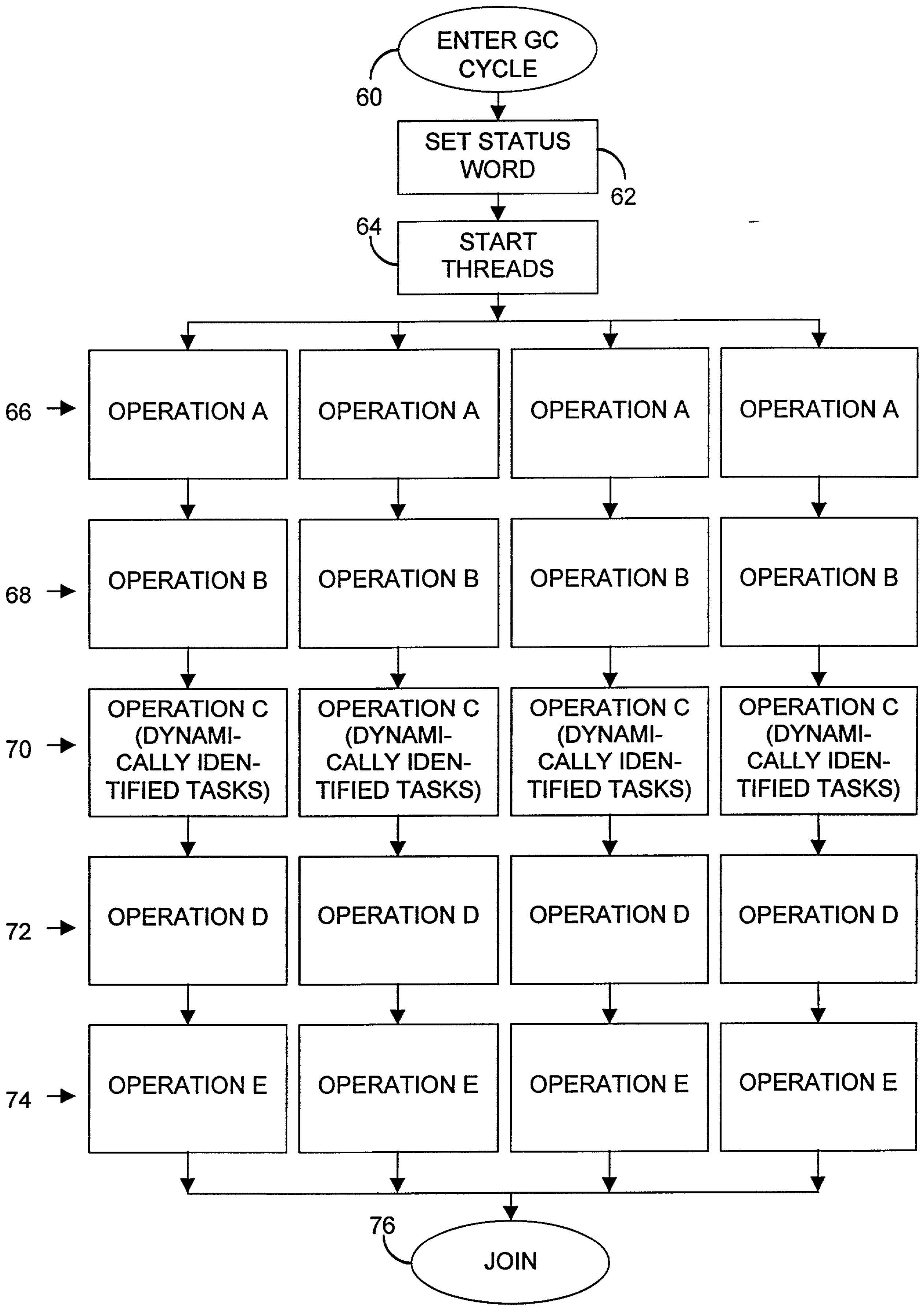

46
40
SOURCE CODE
42
COMPILER
44
BYTE CODE
COMPILE-TIME ENVIRONMENT
48
RUNTIME ENVIRONMENT
JIT COMPILER
56
52
INTERPRETER
50
54
RUNTIME SYSTEM
58
OPERATING SYSTEM

FIG. 4



ENTER GC CYCLE
60
SET STATUS WORD
62
64
START THREADS
66
OPERATION A
OPERATION A
OPERATION A
OPERATION A
68
OPERATION B
OPERATION B
OPERATION B
OPERATION B
70
OPERATION C (DYNAMI-CALLY IDEN-TIFIED TASKS)
OPERATION C (DYNAMI-CALLY IDEN-TIFIED TASKS)
OPERATION C (DYNAMI-CALLY IDEN-TIFIED TASKS)
OPERATION C (DYNAMI-CALLY IDEN-TIFIED TASKS)
72
OPERATION D
OPERATION D
OPERATION D
OPERATION D
74
OPERATION E
OPERATION E
OPERATION E
OPERATION E
76
JOIN

FIG. 5

T0Z290" 952E6860

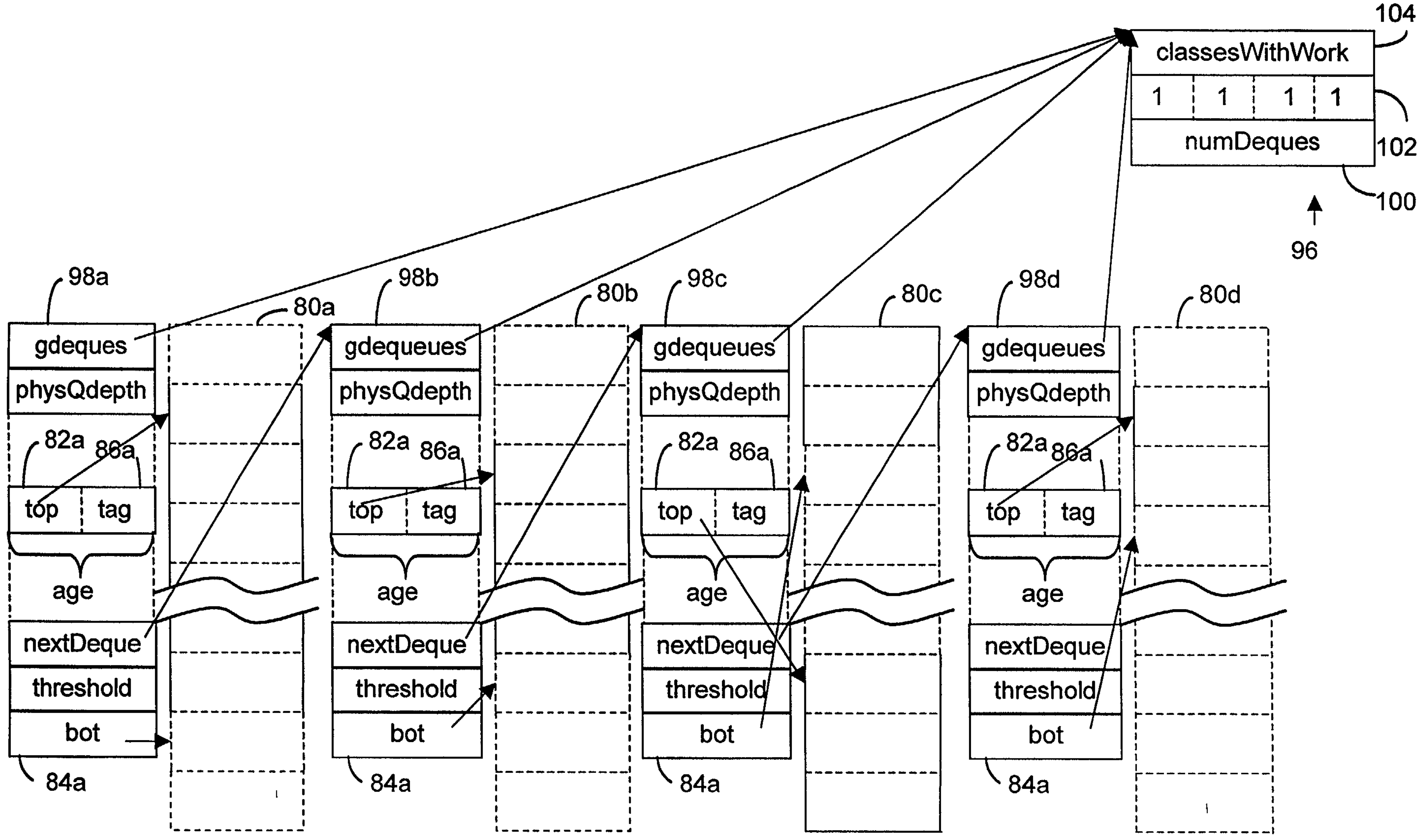


FIG. 6

```
static java_lang_Object * popTop (localDeque *dq){
        dequeAge oldAge = dq->age;
        unsigned int localBot = dq->bot;
        if (localBot == oldAge.top)
                return NULL;
        java_lang_Object * task = dq->objects[oldAge.top];
        dequeAge newAge = oldAge;
        if(++newAge.top==dq->physQdepth) newAge.top = 0;
        dequeueAge tempAge = (dequeAge) casInt((int) newAge,
                (int) oldAge,
                (int*) &dq->age); /*atomic compare-and-swap*/
        if(tempAge == oldAge)
                 return task;
        return NULL;
}
```

FIG. 7

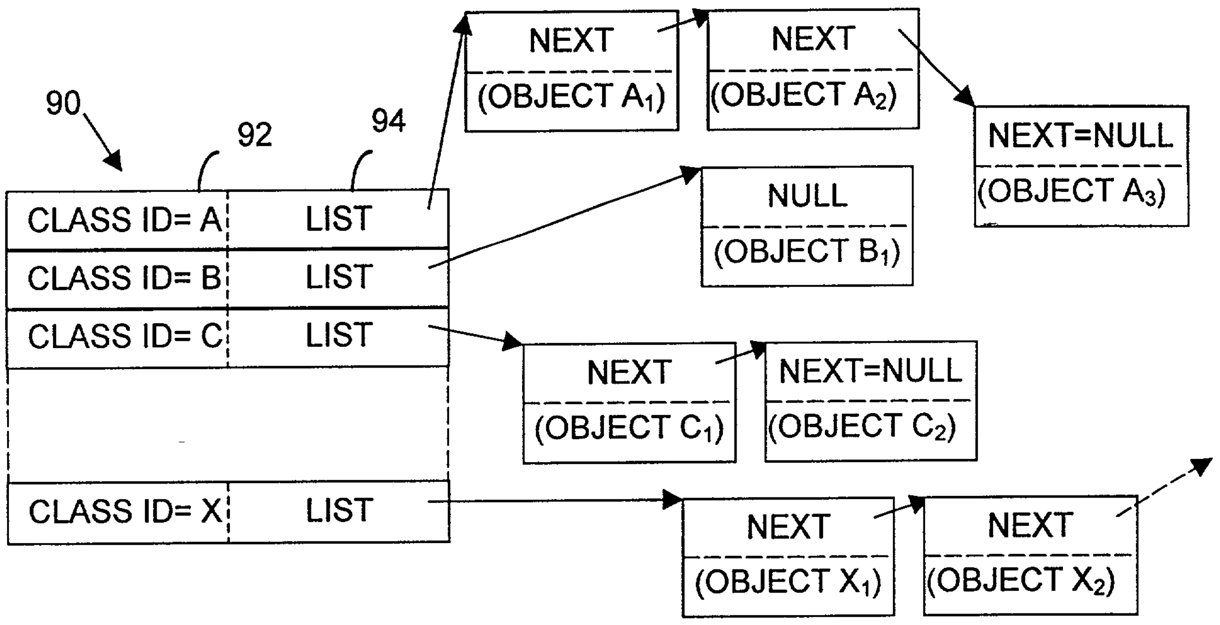
```
static void dequePush (localDeque *dq, java_lang_Object *obj) {
    unsigned int localBot = dq->bot;
    dequeAge oldAge = dq->age;
    if (dequeNumberOfElements (localBot, oldAge.top, dq) == dq->physQdepth-1) {
        dequeOverflow(dq);
        localBot = dq->bot;
    }
    setArrayElement (localBot, dq, obj);
    if (++localBot == dq->physQdepth) localBot = 0;
    dq->bot = localBot;
}

static int dequeNumberOfElements(unsigned int localBot, unsigned int localTop,
            localDeque *dq) {
    int diff = localBot – localTop;
    if (diff < 0)
        diff = diff + dq->physQdepth;
        return diff;
}

static void setArrayElement(int index,
        localDeque *dq,
        java_lang_Object *obj) {
    dq->objects[index] = obj;
}
```

FIG. 8

```
static java_lang_Object *dequePopWork (localDeque *dq) {
    unsigned int localBot = dq->bot;
    java_lang_Object *obj = NULL;
    dequeAge oldAge, newAge;
    int numElems = dequeNumberOfElements (localBot, dq ->age.top, dq);
    if (numElems == 0)
        return NULL;
    if (numElems > dq->threshold) {
        while ((obj == NULL) &&
            (dequeNumberOfElements (localBot, dq->age.top, dq) > dq->threshold))
            {
                obj = popTop(dq)
            }
        if (obj != NULL)
            return obj;
    }
    if(--localBot == -1) localBot = dq->physQdepth - 1;
    dq->bot = localBot;
    obj = getArrayElement (localBot, dq);
    oldAge = dq->age; /* It might have changed */
    if (dequeNumberOfElements (localBot, oldAge.top, dq) > 0) return obj;
    newAge.tag = oldAge.tag + 1;
    newAge.top = oldAge.top
    if (localBot == oldAge.top) {
        dequeAge tempAge;
        tempAge = (dequeAge) casInt ((int) newAge,
             (int) oldAge,
            (int*) &dq->age);
    if (tempAge == oldAge) return obj;
    }
    dq->age = newAge;
    return NULL;
}
```

```
static void setArrayElement(int index,
        localDeque *dq,
        java_lang_Object *obj) {
    dq->objects[index] = obj;
}
```

FIG. 9



90
92
94
CLASS ID= A
LIST
CLASS ID= B
LIST
CLASS ID= C
LIST
CLASS ID= X
LIST
NEXT
(OBJECT A$_1$)
NEXT
(OBJECT A$_2$)
NEXT=NULL
(OBJECT A$_3$)
NULL
(OBJECT B$_1$)
NEXT
(OBJECT C$_1$)
NEXT=NULL
(OBJECT C$_2$)
NEXT
(OBJECT X$_1$)
NEXT
(OBJECT X$_2$)

FIG. 10

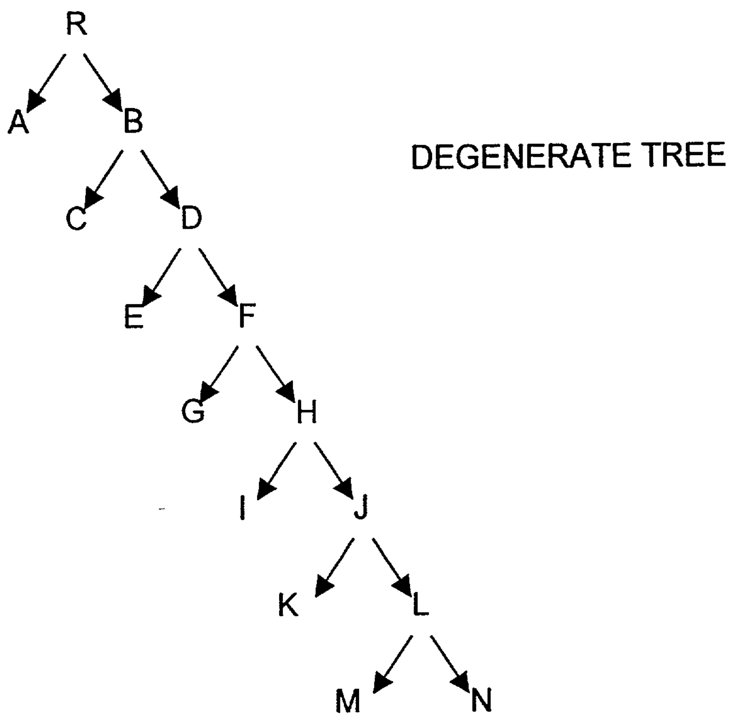


FIG. 11

LIFO SEQUENCE
R
AB
ACD
ACEF
ACEGH
ACEGIJ
ACEGIKL
ACEGIKMN
ACEGIKM
ACEGIK
ACEGI
ACEG
ACE
AC
A

FIG. 12

FIFO SEQUENCE
R
AB
B
CD
D
EF
F
GH
H
IJ
J
KL
L
MN
N

FIG. 13

FULL BINARY TREE

$$\begin{tikzcd}[column sep=tiny]
 & & & & & & & R \arrow[dllll] \arrow[drrrr] & & & & & & & \\
 & & & A \arrow[dll] \arrow[drr] & & & & & & & & B \arrow[dll] \arrow[drr] & & & \\
 & C \arrow[dl] \arrow[dr] & & & & D \arrow[dl] \arrow[dr] & & & & E \arrow[dl] \arrow[dr] & & & & F \arrow[dl] \arrow[dr] & \\
G & & H & & I & & J & & K & & L & & M & & N
\end{tikzcd}$$

FIG.14

LIFO SEQUENCE
R
AB
AEF
AEMN
AEM
AE
AKL
AK
A
CD
CIJ
CI
C
GH
G

FIG. 15

FIFO SEQUENCE
R
AB
BCD
CDEF
DEFGH
EFGHIJ
FGHIJKL
GHIJKLMN
HIJKLMN
IJKLMN
JKLMN
KLMN
LMN
MN
N

FIG. 16

```
java_lang_Object *dequeFindWork(localDeque *dq) {
    java_lang_Object *result = findWorkHelper(dq);
    globalDeques *gdqs = dq->gdeques;
    if (result == NULL) {
        mark_self_inactive(dq->index, &gdqs->statusBitmap); /* You have no work */
    }
    while (result == NULL) {
        if (!gdqs->statusBitmap) return NULL;  /* No one has any work. Terminate. */
        poll(NULL, NULL, 0);
        if (checkForWork(dq)) { /* You don't have any work, but there is some either
                    on the overflow queue, or in another thread's work
                    queue */
            mark_self_active(dq->index, &gdqs->statusBitmap); /* Looking for work */
            result = findWorkHelper(dq);
            if (result == NULL) {
                mark_self_inactive(dq->index, &gdqs->statusBitmap);
            }
        }
    }
    return result;
}

java_lang_Object *findWorkHelper(localDeque *dq) {
    java_lang_Object *task = findWorkInOverflowList(dq);
    if (task == NULL) {
        task = stealWork(dq);
    }
    return task;
}

static void mark_self_inactive(int self, int *pStatusBitmap) {
        int oldValue,newValue;
        do {
                oldValue = *pStatusBitmap;
                newValue = oldValue & (~(1<<self));
                newValue = casInt(newValue, oldValue, pStatusBitmap);
        } while (newValue != oldValue) ;
}

static void mark_self_active(int self, int *pStatusBitmap) {
        int oldValue,newValue;
        do {
                oldValue = *pStatusBitmap;
                newValue = oldValue | (1<<self);
                newValue = casInt(newValue, oldValue, pStatusBitmap);
        } while (newValue != oldValue) ;
}
```

FIG. 17

```
static java_lang_Object *stealWork(localDeque *dq) {
    globalDeques *gdqs = dq->gdeques;
    int degree = gdqs->numDeques;
    int iterations = 2 * degree;
    int i = 0;
    while (i++ < iterations) {
        localDeque *dqToSteal = pickQueueToStealFrom(gdqs, dq);
        if (dqToSteal->bot > dqToSteal->age.top) {
            java_lang_Object *task = popTop(dqToSteal);
            if(!task) poll(NULL, NULL, 0);
            else return task;
        }
    }
    return NULL;
}
```

FIG. 18

```
static bool_t checkForWork(localDeque *dq) {
    globalDeques *gdqs = dq->gdeques;
    return gdqs->classesWithWork || peekDeque(dq);
}
```

```
static bool_t peekDeque(localDeque *dq) {
   globalDeques *gdqs = dq->gdeques;
   int degree = gdqs->numDeques;
   int i;
   for (i = 0; i < 2 * degree; i++) {
      localDeque *dqToPeek = pickQueueToStealFrom(gdqs, dq);
      if (dqToPeek->bot > dqToPeek->age.top) {
         return TRUE;
      }
   }
   return FALSE;
}
```

FIG. 19